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Lubrication

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THIS ISSUE

Lubrication of War Production Machine Tools

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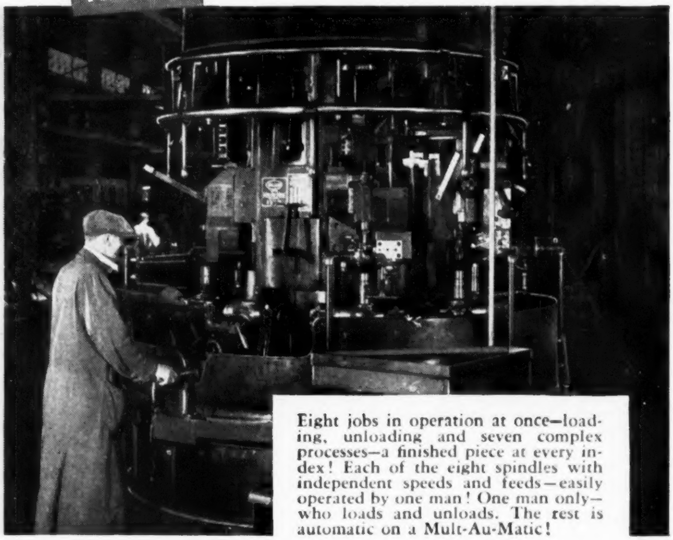

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LUBRICATION

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Lubrication of War Production Machine Tools

RE-TOOLING for war production has led to stream-lining of the modern machine tool from the viewpoint of conservation of energy. Many of the massive pre-war tools required man-power as such for adjustment and handling of the work. The war-plant tool has been converted with an eye to conservation of physical effort. This is why it can be operated so ably by women.

When production demands used to be increased there was also the possibility of neglected lubrication. It gave the careless operator an "out" if he disliked using the oil can or pressure grease gun. Conversion did another good job when it converted most of the modern war production tools to automatic lubrication. Here again conservation of physical energy was an objective,—furthermore, being relieved of keeping the oil can in mind has enabled the operator to pay more attention to production.

The modern machine tool must function on a low-cost high output basis, with minimum scrap loss. All this requires capacity, speed, power, accuracy, rigidity and ease of operation. It is interesting to note that tool builders apparently regard automatic lubrication as a prominent factor in the attainment of these objectives. Tool design has also been directed toward better protection of the parts to be lubricated, notably the ways on the heavy duty turret lathe and the spindle bearings on the grinder.

This trend towards protective lubrication is highly significant. It is gratifying to note that progressive designers realize that for a lubricant thoroughly to protect the parts it is to lubricate, in turn it must be protected. Building the lubrication system into the machine is a long step in this direction.

THE BASIC MECHANISMS

As a general rule lubrication recommendations can be simplified materially if the basic mechanisms are analysed and studied with respect to the design and means of lubrication which is provided. This is exemplified by the accompanying Chart.

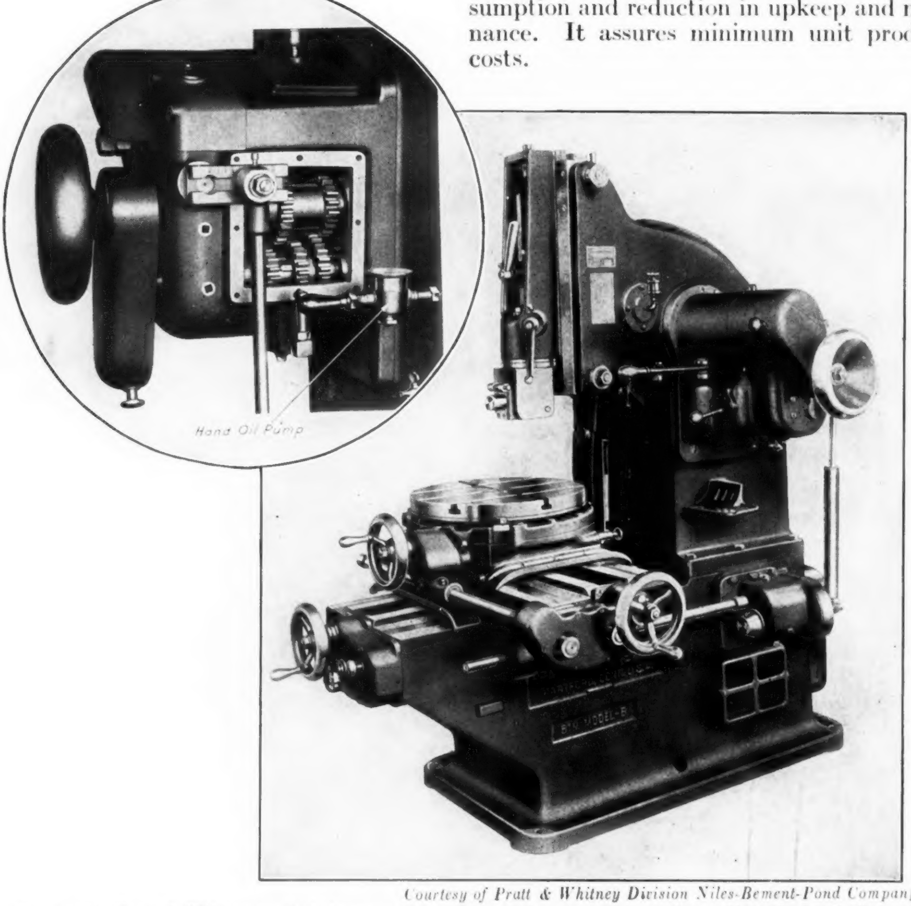
With an understanding of the type of construction, speed and temperature become the criteria as to the body or viscosity of the lubricant; the extent of load and type of metal composing the contact surfaces dictate whether or not extreme pressure additives are necessary.

It is interesting to study machines which are designed to produce parts of other machines which can only function successfully when protected by lubrication, for the production machines—the machine tools—must be equally as well protected by lubrication. This fact has been fully appre-

ciated by builders of machine tools, consequently centralized lubrication has been widely incorporated in their design. This means that the gears, bearings, slides and guides of the modern lathe, planer, milling machine, boring mill, shaper, slotter, etc., are often lubricated simultaneously by means of bath, splash or pressure oil circulation. Pressure grease lubrication or hand oiling, in turn, predominates on individual external bearings.

In war production service this insures less time out for repairs, reduced wear, less noise (which would otherwise accompany poorly lubricated gearing) and naturally longer machine life. This coordination of effort makes it possible to cut with far greater accuracy, for by reducing the rate of wear, clearances between moving parts are maintained more constantly, thereby reducing the need for adjustments which so often may affect the accuracy of cutting.

To many, of course, the more spectacular function of cooling and lubricating cutting tools may appear to be the most prominent duty of petroleum products in machine tool operation. With this mistaken idea some still regard gears, bearings and slides as more or less incidental. As a matter of fact, however, effective general machine lubrication with reduction of frictional resistance, is one of the most salient factors in the attainment of maximum war production. It means economical power consumption and reduction in upkeep and maintenance. It assures minimum unit production costs.



Courtesy of Pratt & Whitney Division Niles-Bement-Pond Company

Fig. 1—The Pratt & Whitney vertical shaper, and rear view of the ram speed gear box. Note the hand oil pump which serves the ram activating mechanism.

POWER TRANSMISSION

Machine tools are motor driven through speed reduction gearing or an hydraulic power-transmission device. As the speed of the cutting mechanism normally will be lower than the speed of the electric motor reduction gears are necessary for both power transmission and speed control. Any variation in their operation may cause decided variations in the rate of production. Effective lubrication assists materially in preventing these variations.

Gear Lubrication

Gear lubrication depends upon the design, construction and location with respect to other parts of the machine; it requires the maintenance of a sufficient and continual film of lubricant on the wearing surfaces of the teeth. complete the system, however, requires that the elements be contained in some form of oil-tight casing or housing. This assures against loss by leakage and that the gears will continually dip into the bath of lubricant to a sufficient extent to enable the teeth to carry or

Chart Showing the Basic Mechanisms

BEARINGS	Sleeve type	Oil lubricated	Ring oilers Oil cups Oil circulation
		Grease lubricated	Compression cups Pressure gun
	Anti-friction Ball or Roller	Oil lubricated (where oil tight) Grease lubricated	Pre-packed Pressure gun
SLIDES	V-type Flat	Oil lubricated	Pressure circulation Roller oil circulation
CAMS	Sliding Contact	Oil lubricated Grease lubricated	Hand application
GEARS	Spur	Exposed	Dip lubricated—heavy oil Hand lubricated—heavy oil
		Enclosed	Bath lubricated—oil Pressure lubricated—oil
	Bevel Herringbone	Usually enclosed	Bath lubricated—oil Pressure lubricated—oil
	Worm	Usually enclosed	Bath lubricated—oil
CHAINS	Roller	Exposed Enclosed	Hand lubricated—heavy oil Dip lubricated—oil
	Link type (silent)	Enclosed	Bath lubricated—oil Oil circulation

This can be accomplished either by means of fluid oil or a more inert form of gear lubricant according to the means provided for application. Both promote reduction of noise. This is a distinct benefit.

Reversing gears are of particular interest for in proportion to the extent to which the noise of reversal is reduced, one can estimate the degree to which the lubricant is functioning as a buffer, shock absorber or silencer. The reduction of these shocks of reversal, of course, will promote greater durability of all the wearing parts adjacent to or affected by such operations.

When gears are lubricated by bath or splash relatively fluid oils are involved, furthermore the procedure is automatic and continuous just as long as the level of the lubricant is properly maintained while the gears are turning. To splash the necessary supply of oil to those of the train which are located above the oil level. Interior gear shaft bearings are lubricated simultaneously by the same oil.

Pressure lubrication can be developed by means of a suitable oil pump located in the oil sump. In this way oil can be delivered to the gear teeth in streams of sufficient volume to maintain the requisite film of lubricant without flooding. Pressure or force feed lubrication will usually develop a sufficient amount of splash to take care also of the bearings within the gear case, although on some machines the oil may be piped directly to the most important from the oil pump.

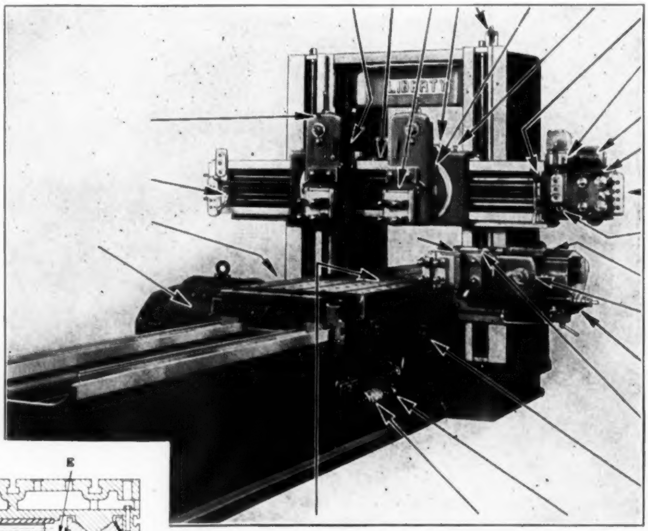
A medium bodied straight mineral machine oil will usually be best where splash, bath or pressure lubricated systems are installed, the viscosity ranging from 300 to 500 seconds Say-

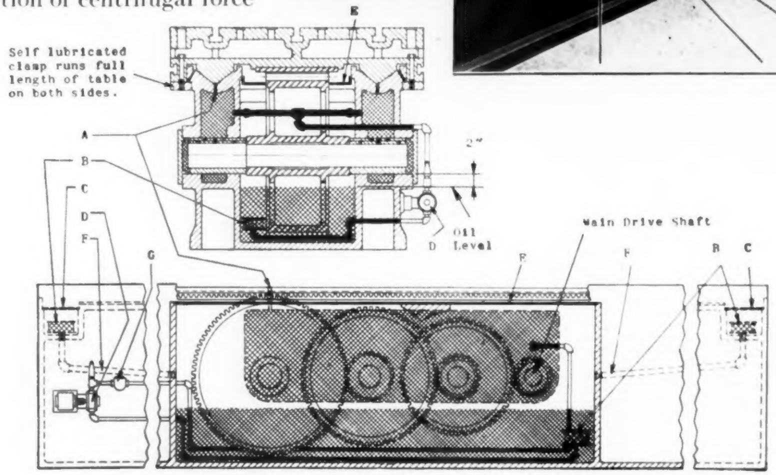
bolt Universal at 100 degrees Fahr. A fluid oil of this nature can generally be employed on many of the other moving parts, such as external bearings, guides and slides which may be apart from the gear lubrication system.

therefore, be carefully approached. It should be as light or fluid as possible, commensurate with the tooth pressures involved, the means of application available and the extent to which throwing can be controlled.

Exposed Gears

Exposed gears such as the back gears on certain types of engine lathes, or units where gear casings are not oil-tight, require that the lubricant be applied to the teeth by hand swabbing. Under such conditions a heavier or more adhesive gear lubricant must be used, for the lubricating film will have to function for a considerably longer period of time in the prevention of metal-to-metal contact. This is assured if it sticks tenaciously to the teeth, resists the action of centrifugal force and the contaminating effects of dust or dirt.





Courtesy Liberty Planers

Fig. 2—The Liberty double housing planer. Arrows on the photo show lubrication fittings; the line sketch shows details of the Liberty force feed lubrication system for bed gearing, bearings and Vees: A—Opening from oil reservoir to vee; B—Strainer to filter oil; C—Strainer screen to catch large chips or dirt; D—Motorized oil pump; E—Sheet iron covers protecting gearing; F—Return pipe lines to main reservoir; G—Oil filter.

A variety of products are available for such service, ranging from the semi-fluid type of automotive gear lubricant to the heavier products so extensively used on excavating and mining machinery. Some, of course, would be too inert and viscous for use in the lighter, more finely cut gear trains in the average machine tool, inasmuch as they would require altogether too much power for operation. They would lubricate, but at the same time they would impose an abnormal amount of drag which might reduce materially the speed of operation. Selection of such a lubricant must,

Application of Gear Drives

Gearing is so important in machine tool service that tools are often classified according to their type of drive. On the lathe in addition to the driving gears we are concerned with the quick change gears which operate the power feeds; the back gears on engine lathes; and the bevel gears and pinions which reverse the direction of feed on some lathe aprons.

Planers, in turn, are often referred to as being of the worm, spur or helical gear driven table type. This drive requires a rack which extends over the length of the entire underside of the table. The main gear of the driving

train meshes with this rack. On the worm drive planer a worm wheel is used instead of the "bull" gear. Careful attention to the design of the driving gear train on a planer is necessary due to the relation between the cutting and return speeds. This requires very careful lubrication of the entire gear assembly for any undue wear on the teeth with resultant "backlash" or pounding will affect the accuracy of the cut. The cooling effect of bath lubrication is very beneficial on these installations.

Hydraulic Power

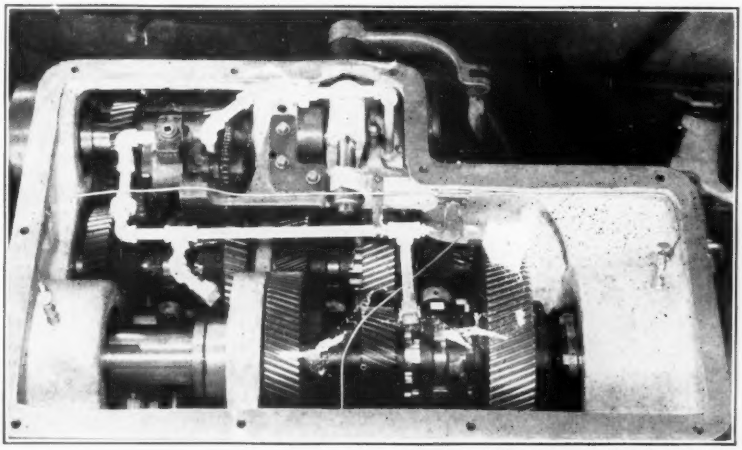
Power transmission by oil hydraulic means is adaptable to all types of metal working tools. By using a rotary type pump and a rotary hydraulic motor, electric or mechanical power can be converted into hydraulic power of variable speed which can be most accurately controlled. Furthermore, the direction in which this power is delivered can be reversed irrespective of the direction in which the driving motor is operating.

Hydraulic power operation of the ram table and other mechanisms in precision grinding is one of the outstanding contributions to smoother motion and elimination of shocks of reversal. This has enabled speed-up with scarcely any increase in load upon the essential lubricants, especially as all the component bearings usually are pressure lubricated.

Type of Oil

The type of hydraulic oil and its protection are most important items in the operation of such a system. Only lubricating oils of very careful refinement should be used. It is especially important that they be entirely free from abrasive or contaminating foreign matter. They must be similarly protected in service. Machine tools designed for oil-hydraulic control, therefore, are provided with a suitable oil filter as part of the hydraulic system. When putting a new machine in service, all piping and accessory parts should be very carefully cleaned.

Resistance to oxidation and carbon-formation are the other outstanding characteristics. They will indicate the durability of the oil and its resistance to breakdown. Viscosity is only of importance as an indication of the body or relative fluidity. According to the type of hydraulic system it may vary from 100 to 1200 seconds Saybolt Universal at 100 degrees Fahr. High pumping pressures and operating temperatures require heavier oils, the range depending upon the type of system, the extent to which pipe lines may be restricted and the necessity for keeping down pipe line head loss.



Courtesy of The Monarch Machine Tool Co.

Fig. 3—Top view of the gears of a Monarch lathe showing oiling facilities.

Lubricating the Mechanisms

Lubrication of the pump and motor mechanisms in an oil-hydraulic system is maintained by allowing for a certain amount of oil leakage past the operating mechanisms. There is no loss of oil, however, for the oil which lubricates is drained back into the oil reservoir of the system for re-usage.

Keep Air Out of the System

Air in an oil-hydraulic system is a detriment; for example, it may cause too harsh carriage reversal on a grinder. For this reason filling the system must be carefully approached to insure that it is entirely full of oil and as free as possible from air.

Air is most likely to enter the system when adding oil, although air leakage can also develop between the reservoir and pump or, at some high point of the system. Normally, however, any leak which will permit entry of air will permit oil to pass out especially when the pump is operating at full stroke. Leaky packing or a restricted pump intake due to sludge accumulations may also lead to air leaks.

Some authorities have found that entry of air at the time of filling can be materially reduced by adding make-up oil very slowly and straining the fresh oil through a few layers of cheesecloth. Air relief valves are helpful at the high points in the system. Removal of air is also accelerated by locating a baffle plate in the oil reservoir; this gives the air bubbles a better chance to rise. Lighter oils can be more easily freed from air than heavier oils.

LUBRICATION OF BEARING SURFACES

Machine tool design involves a variety of bearings, based on the principle of the sleeve type babbitted or bronze bearing, or some form of ball or roller bearing. There are also the thrust bearings as installed on some types of lathes for the purpose of taking up any end thrust exerted by the spindle.

Spindle Bearings

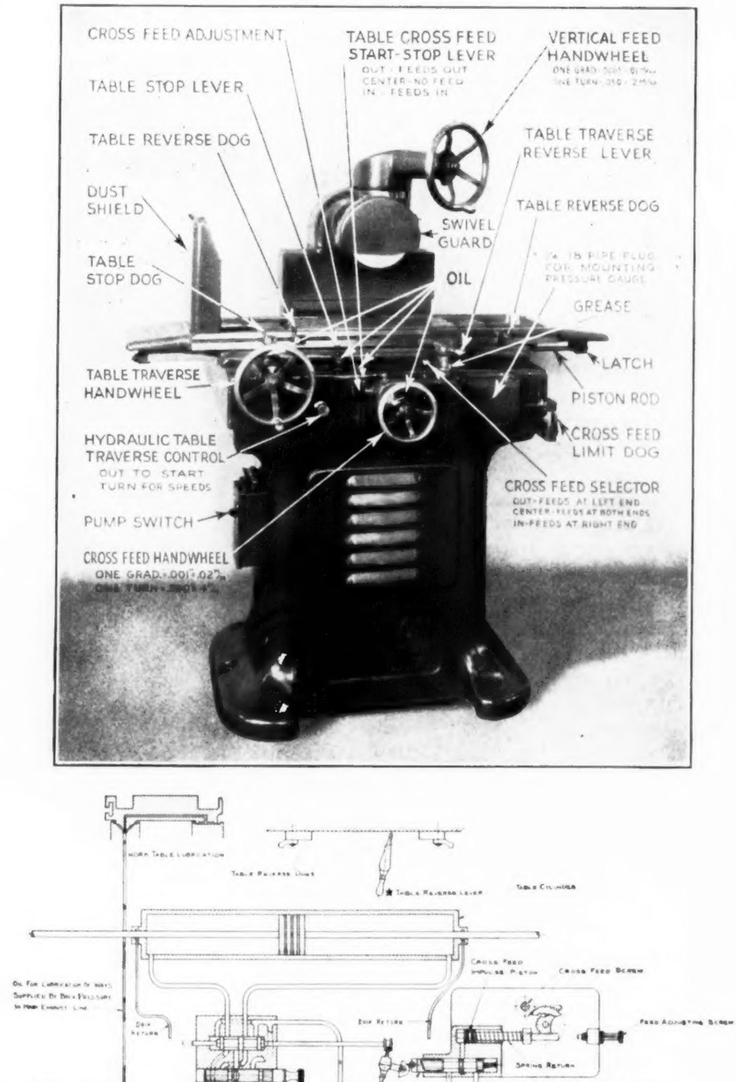
As spindle speeds have been increased, rigidity of the spindle mounting has had to be more carefully considered. This is accomplished by locating on the heavy duty turret lathe, for example, extra supporting webs at the front spindle bearing. This effectually prevents spindle wobble or uneven bearing wear, either or both of which might easily lead to inaccuracies of cutting.

The Pre-Lubricated Anti-Friction Bearing

The grease-lubricated ball or roller bearing, prepacked at the time of assembly is a pronounced factor in reducing the amount of relubrication required on the modern miller and profiler. As such a bearing requires no future lubrication, the chance of over-greasing and damaged bearing seals is eliminated. This obviously is a factor in maintenance as it involves the main spindle bearings and the bearings of the table and cross slide feed shafts.

Automatic Lubrication Also a Factor

Bearings are quite susceptible to the development of abnormal friction if lubrication is insufficient. Even so this fact is overlooked, under the pressure of high speed production very often with the mistaken idea that because operating conditions may be somewhat severe, any extra attention to bearing lubrication is not warranted. This is false economy, especially in war production service

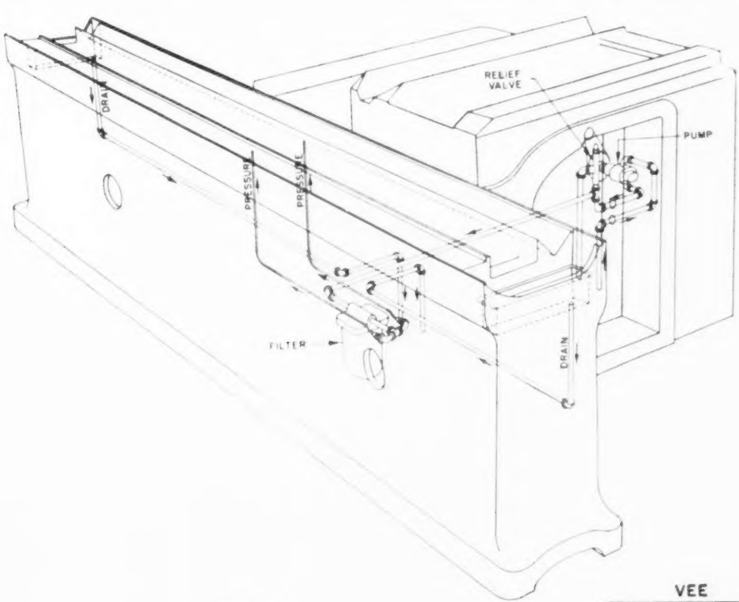


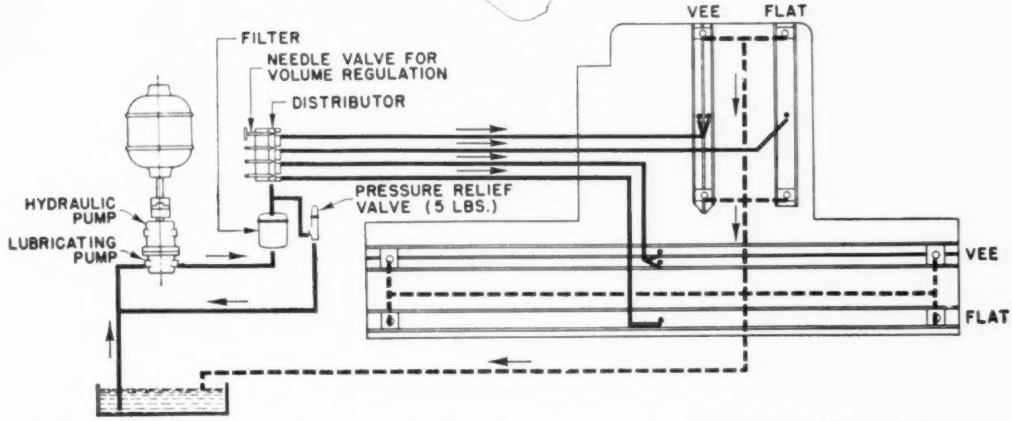
Courtesy of Norton Company

Fig. 4—View of a Norton surface grinder with notation of the points of lubrication, etc. Note also the details of the oil-hydraulic oiling system. Arrows indicate flow of oil.

where the machine tool industry, and the machine tool operator have too much at stake to disregard that factor (adequate lubrication), which keeps their machinery in proper operating condition.

The application of automatic lubrication to well adapted to lathes, planers and milling machines. On high speed, deep cutting of harder steels the pressures exerted on certain of the bearings will be relatively high. Where clearances are fairly generous, and an oil of sufficiently high viscosity is used, the lubricating film will usually be thick enough under ordinary conditions to prevent abnormal wear. The relation to cutting, however, must not be overlooked. High clearances may defeat the attainment of the desired accuracies in cutting; they are not desirable, therefore, on machine tool bearings where fine work is involved. Pressure lubrication is beneficial under conditions of low clearance design. Furthermore, it enables the use of a lighter grade of oil,





Courtesy of Cincinnati Grinders, Inc.

Fig. 5—(Above) Lubrication d tails of a Cincinnati hydraulic g inde showi g oil lines, oil filter and oil pump. (Below) The circuit diagram for automatic lubrication of the ways.

machine tool bearings at first developed as an offshoot of gear lubrication. This applied particularly to gear shaft bearings and certain others which were enclosed so that they could be automatically lubricated by splash or force feed along with the gear teeth. Some manufacturers carried this one step further and designed their oiling systems with leads to the more important external bearings and slides as well. Then centralized lubrication followed.

Centralized force feed lubrication can be especially where the pressure on the lubricating system is sufficient to assure of complete penetration between all moving parts.

Centralized lubrication must be planned in accordance with the nature of the work required, the prevailing pressures and the type of machinery to be lubricated. On the milling machine and planer the installation of oil reservoirs of sufficient capacity, or mechanical force feed lubricators simplify the problems of design and construction.

In contrast, there are other types of machines

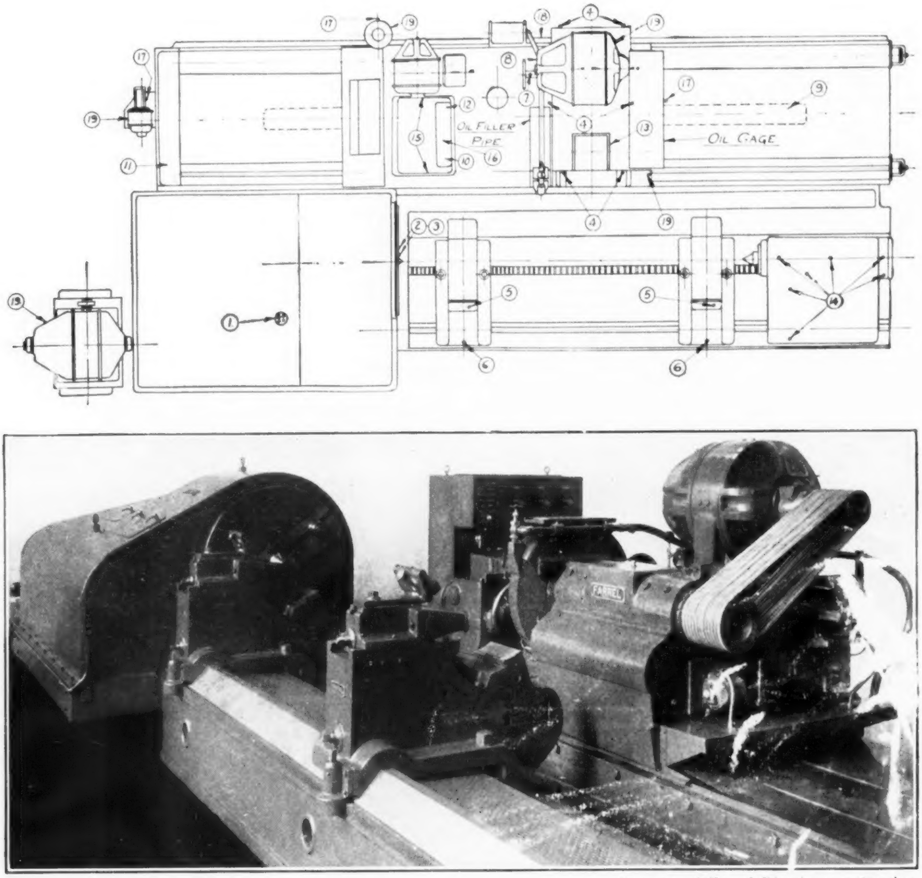
where more complete flood lubrication is regarded as a practical necessity. These latter machines are equipped with self-contained oiling systems, the lubricant being pumped to the bearings, gears and slides by means of a pump contained either in the oil reservoir or located at some convenient external point on the machine.

Sliding Guides and Vees

Slides, Vees, guides or ways also can be lubricated effectually by automatic means. They are usually less prominent than the bearings and gears on the average machine tool, yet they play a most important part in coordinating the functions of the lathe, planer and shaper. On the former, for example, there will be the bed on which the carriage moves, the guides on which the turret saddle and cross-slide carriage travel, and the necessary Vees which serve to keep the carriage in proper position with respect to the table.

Protecting the Ways

The way cover is one of the outstanding developments in lathe design which is contributing to more dependable lubrication. Before Vee bedways were protected there was always possibility of damage to these important bearing surfaces if the lubricating film should be washed off by a flood of coolant, or if chips accumulated to scratch the surfaces. By covering the ways effectively these detrimental conditions are eliminated to result in smoother operation and maintained accuracy of cutting. By designing the Vee ways so that they are self-aligning, in turn, the possibility of uneven wear is largely eliminated, thus reducing the localized overloading of the lubricant.



Courtesy of Farrel-Birmingham Co. Inc.

Fig. 6—Lubrication diagram and exterior view of a Farrel heavy duty roll grinder. Numbers indicate the parts to be lubricated.

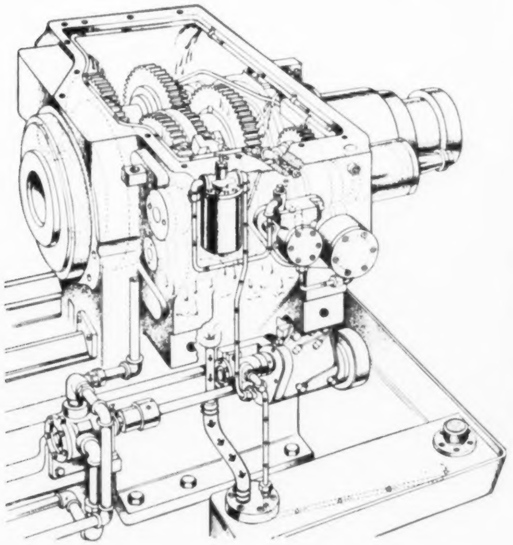
Reciprocating Motion Involved

Sliding surfaces are subject to comparatively slow reciprocating motion. In many cases, however, the pressure will be high, especially on horizontal machines such as the planer and

turret lathe. This may lead frequently to excessive wear and increased power consumption in case such surfaces are not properly lubricated. Ultimately the machine may be thrown out of line. Lubrication of sliding surfaces, therefore, must be carefully considered beginning with the design, and later during erection and in operation. It is a phase of the general problem of lubrication which can easily develop difficulties which may affect both the operator and lubricating engineer.

Relation of Load to Oil Viscosity

An interesting formula is proposed by one builder which indicates that the relation between the weight of work, width of the Vee



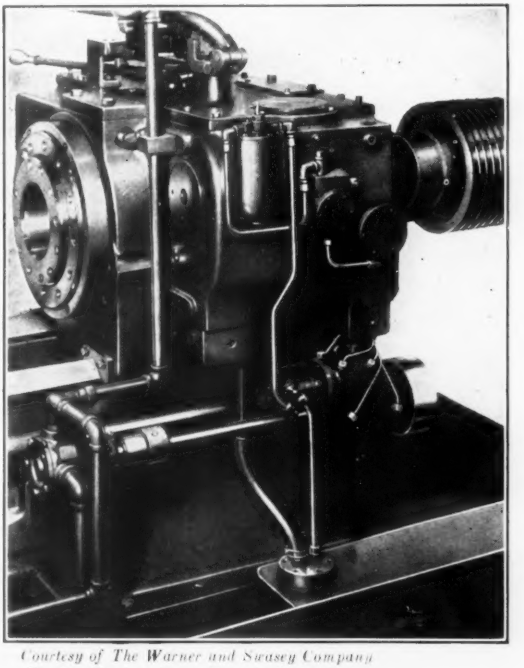
bearing and the table length can be used to good advantage in calculating the bearing load. This latter can then be interpreted in terms of the viscosity of the oil which should be used. Obviously this viscosity must be sufficient to maintain an adequate film of from 0.0005″ to 0.002″ according to the work load. Lower viscosity oils within certain limitations enable most accurate cutting. The formula referred to above states that the bearing load equals:

$$\frac{\text{weight of work}}{\text{width of Vee bearing x table length}}$$

Experience has indicated that for bearing loads below 10 p.s.i. an oil viscosity of from 300 to 500 seconds Saybolt Universal at 100 degrees Fahr. is adaptable. Otherwise use a somewhat heavier oil.

Alignment is Most Essential

On both the lathe and planer where one of the primary functions of the Vees or guiding grooves is to keep the table lined up with respect to the cutting tool, the accuracy of cutting and the resultant work will depend upon the extent to which alignment is accomplished. Pressure lubrication has been adopted by certain builders, splash lubrication by others, as the means to assure success in this regard.



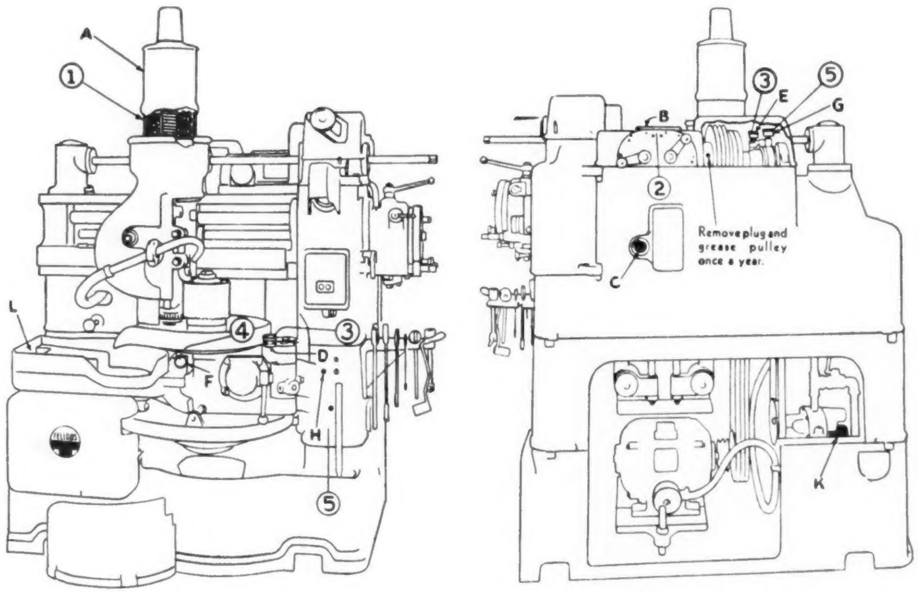
Courtesy of The Warner and Swasey Company

Fig. 7—Headstock details and oil circulating system for a Warner & Swasey heavy duty turret lathe. Complete flood lubrication prevails to the clutch parts and all bearings and gears.

Where pressure lubrication is employed, it is generally designed to serve not only the Vees but also the guides, bearings and adjacent gearing. Force feed lubrication, if properly maintained under adequate pressure floats the sliding elements virtually on a film of oil. Any imperfections in the contact surfaces, excessive loading or inadequate lubrication, may lead to more or less vibration in some type of machines; it can be reduced materially by positive lubrication.

Mechanical force feed lubricators are entirely self-contained with regard to oil pumps and reservoirs. Any such device can be attached to an existing machine with practically no alteration of the arrangement of the operating mechanisms; all that is necessary is to plan and install the oil piping from the respective pumps to the parts to be lubricated. Pressure lubrication by means of the mechanical force feed lubricator is advantageous in that flow of oil to each part can be accurately controlled so that

as nearly as possible the right amount of oil can be supplied. In this the mechanical lubricator is comparable with the sight feed oil cup which is so readily adapted to external parts, such as guides and slides. Both can be installed at a convenient level to facilitate refilling and adjustment.



Courtesy of The Fellows Gear Shaper Co.

Fig. 8—Showing the points of lubrication which are featured in the builders' instructions for lubrication of a Fellows gear shaper.

Felt wipers attached to the sliding elements, with means for saturation with oil at frequent intervals, have also proved adaptable on some machines. Wipers are advantageous not only because they serve to keep the Vee grooves clear of dirt but also because they reduce the possibility of scoring of the wearing surfaces. Still another method of Vee-lubrication, which is found on many lathes, etc., involves a number of wheels, discs or rollers free to revolve in depressions or reservoirs located in the Vee-grooves, their surfaces being held in close but not rigid contact with the Vee-shaped projections on the sliding elements. As the latter slide over these rollers, they rotate and carry a film of oil to the projections from the reservoir below, thereby functioning in much the same manner as a ring oiler on a rotating shaft. As long as the oil in the reservoir is kept at such a level as to insure constant dipping of the lower parts of the rollers, lubrication will be positive and entirely automatic.

SELECTION OF BEARING LUBRICANTS

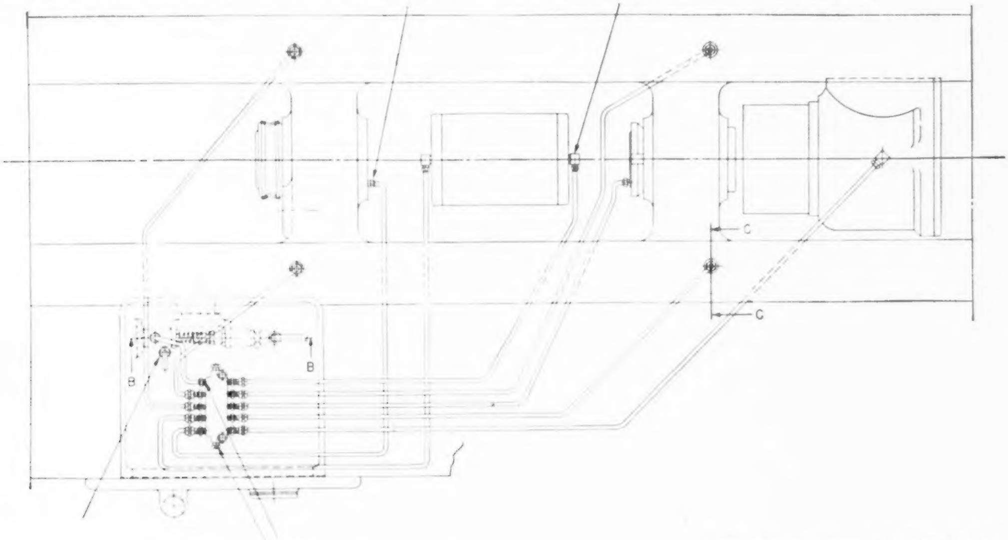
Keeping the number of lubricants employed to a minimum is as essential as conservation in their application. This becomes all the more important in war-time when military and naval requirements for lubricants are so extreme. Consequently, when oil is necessary for general machine tool lubrication in connection with pressure, splash or individual oil cup lubrication, design should be arranged so that one grade can serve all the wearing parts. Provided the possibility for excessive leakage is not too great, a machine oil having a Saybolt Universal viscosity range of from 200 to 500 seconds at 100 degrees Fahr. will normally be suitable.

Grease lubrication is generally confined to individual servicing of the respective bearings. Grease is applied by the compression grease cup, pressure grease gun fittings, or a multiple fitting lubricator which renders actual application of grease to each part more automatic. Grease lubrication is applicable wherever bearing design or construction would allow oils to drain or leak out from clearance spaces prematurely and cause waste or a hazardous condition around the machine. Grease-lubricated anti-friction bearing rollers on the cross slide guide of the heavy duty turret lathe promote better cutting to a smooth accurate taper under present-day operating conditions.

Selecting the Grease

Greases are selected according to their stability, lubricating characteristics and ease of application. They are compounds of relatively fluid oils and certain soaps, and hence are only as effective from a lubricating view-

point as the oils which are used in their manufacture. The soap content serves mainly as a carrier to hold the oil in suspension until it is delivered to the bearings. Accordingly the base and lubricating ability of the mineral oil content are of interest. It is obvious that a grease should remain in as nearly as possible a state of perfect stability, with the minimum tendency towards oil separation; otherwise oil leakage may occur and soap accumulation in bearing oil grooves may result to affect the subsequent protection of the bearings.



Courtesy of Sunstrand Machine Tool Co.

Fig. 9—Lubrication diagram for a Sunstrand "fluid-screw rigidmil." Arrows denote Bijur lubricator fittings.

HOW TO PREVENT CONTAMINATION OF LUBRICANTS

Contamination of lubricants in machine tool service should be investigated according to whether it is most likely to occur

a. During storage, or

b. While in service.

Protection of lubricants while in storage or while being handled from the oil room to the machine, is dependent upon the care observed in handling. In reality it becomes a matter of educating the shop personnel to the importance of preventing unnecessary wear by foreign materials which have contaminated the lubricants due to carelessness. Sometimes the actual dollars and cents cost of shutdown can be prevented, but even more important today is the loss in production and man-hours, if wear has progressed sufficiently to necessitate shutdown for repair.

Protection During Storage

Contamination in storage will depend largely upon the location of the oil house or oil room and the nature of its construction. If located adjacent to the yard hoist, or in a corner of a power plant building, where doors or windows must be left open, or when they are poorly screened, air drafts may often cause circulation of considerable abrasive dust or dirt. It will be only necessary to leave oil or grease in open containers for a short time under such conditions to result in absorption of whatever dust may settle on the surfaces. Inasmuch as virtually any type of dust is abrasive, lubricants which have been thus contaminated will very frequently tend to promote wear, by virtue of their dust content, rather than leading to its reduction by reason of their lubricating ability.

This is largely prevented if lubricants are stored in enclosed tanks or drums, with tightly fitting covers on all containers which have removable heads. Where oils are consumed in sufficient volume to warrant bulk storage, large permanent tanks should be installed into which the contents of shipping drums can be emptied or which can be filled directly from tank cars or trucks. Storage tanks of this nature are sealed to prevent leakage of oil or entry of air. They are usually equipped with measuring pumps, return drains, gauge connections and suitable covered hatches for inspection.

Contamination at the point of distribution can be even more positively prevented if oils are drawn only into clean distributing containers, and in just sufficient amounts to cover immediate requirements.

The possibility of water contamination of greases must always be guarded against. Certain greases, according to their nature and the purpose for which they are intended will con-

tain more or less water. This is an accurately determined quantity. As a result, should any more gain entry, there will be a possibility of the physical and chemical nature of some greases becoming decidedly altered.

Handling of greases and other heavy lubricants also must be given careful consideration. In view of their consistency they must usually be scooped from the containers. This can only be done by hand. During such a procedure there will be considerable possibility of dirt gaining entry, especially if scoops or paddles have been kept where they could gather dust.

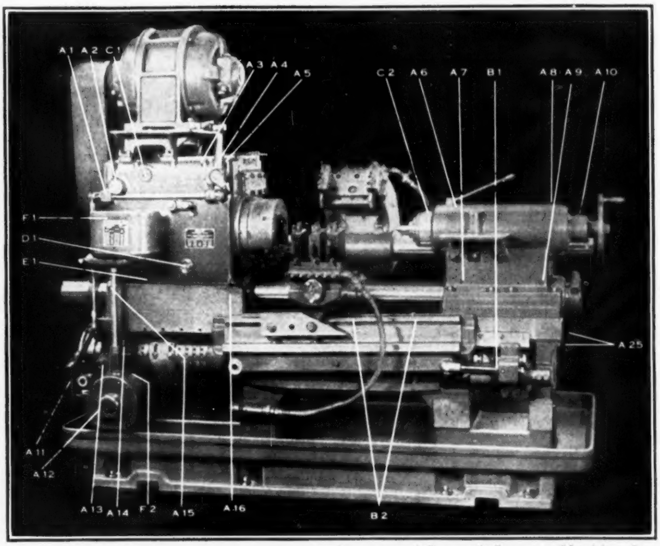
Dirt may also fall off from dirty clothing. It is virtually impossible for one to keep clean around some parts of many machines; as a result all should not have access to lubricant storage. It is far better to detail only certain members of the plant personnel to work in connection with lubricants and lubrication. They at least can keep cleaner than many of the others; in addition they can keep the lubrication records, and economy in issuing the various products can be practiced.

Protection in Service

After lubricants have been issued to the several departments, protection against contamination must be observed by the individuals responsible for their application.

Bearing wear by contaminated lubricants may become especially serious. Scoring or wear in a bearing will usually develop rapidly, for it will normally not require very much abrasive matter in the lubricating film to damage a bearing. For this reason machine tool bearings are usually constructed so as to prevent entry of dust, dirt or scale. With sleeve bearings of the grease lubricated type, the collar of grease at the exposed ends will often serve as a very good seal. How much abrasive foreign matter may gain entry will largely depend upon the condition of the lubricant and how it is applied.

Where automatic lubrication is involved, renewal of oil will only be necessary at infrequent intervals. With the sight-feed cup or unit-oiling device daily filling may be necessary, dependent upon the extent of operation and the capacity of the cup. This will require keeping an oil container at hand. If this latter is properly covered, or kept under the hood of an auxiliary storage tank, the purity of the contents can be preserved. If, however, it is allowed to remain open and exposed to dust or dirt, the oil therein may very soon become badly contaminated.



Courtesy of Jones & Lamson Machine Co.

Fig. 10—Lubrication layout as applied to a Jones and Lamson automatic lathe. Builders chart indicates the type of lubricant suggested for each part.

CONCLUSION

Before the war, when there used to be more time for practical field research and plant study of the lubrication requirements of machine tool operating mechanisms, some very interesting data were accumulated. The petroleum technologist used these data to good advantage in perfecting the accepted grades of lubricants which today are performing so effectually in keeping war-production tools in service.

Twenty-four hour duty must be anticipated in designing for the manufacture of any lubricant, but virtually continuous service under over-speed and over-load conditions was not expected until after Pearl Harbor. That the petroleum technologist included an ample factor of safety in his research is borne out by the production records in any plant concerned with the working of metals by machine tools. These records never could have been attained and surpassed if faulty lubrication had made it necessary to take too much time out for repair.

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INDIVIDUAL OILERS—Bearings and Slides	Texaco Regal Oil C or E or Texaco Aleph, Altair or Aries Oil
GREASE LUBRICATION—Bearings and Slides	Texaco Starfak Greases
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EXPOSED GEARING, OR WHERE HOUSINGS ARE NOT OIL-TIGHT	Texaco Thubans or Texaco Craters

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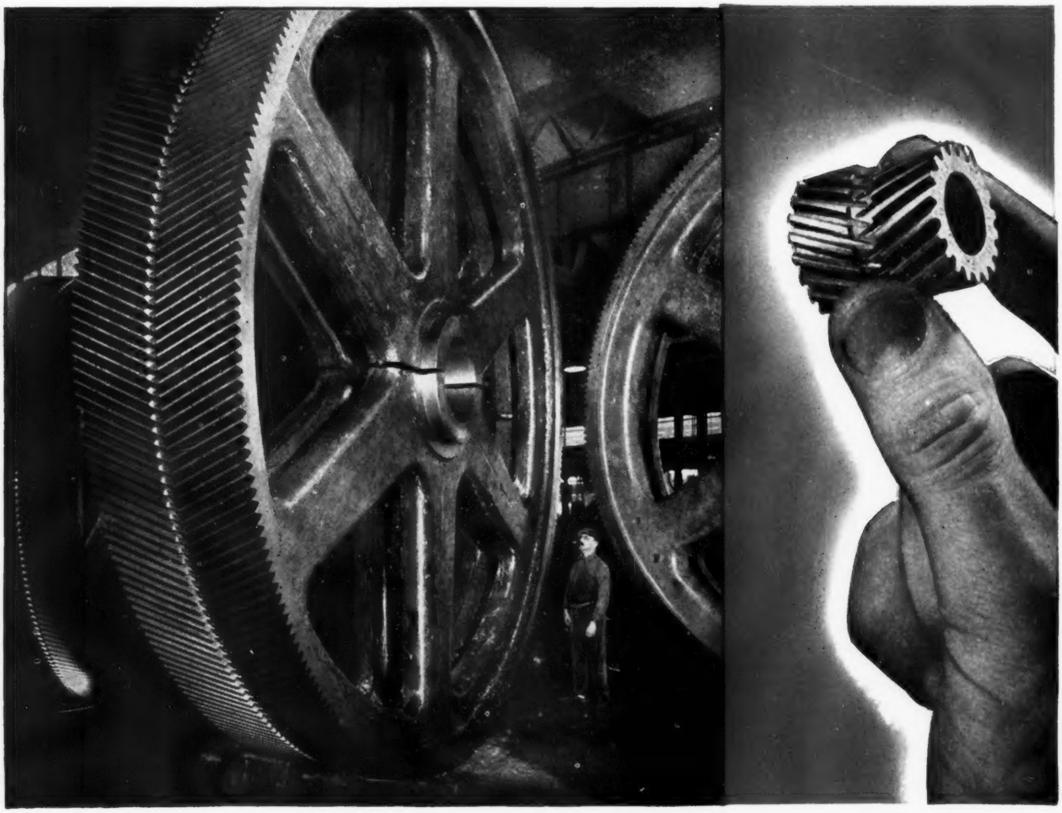
WHERE HOUSINGS ARE OIL-TIGHT	Texaco Regal Oil B or C or Texaco Capella Oil B or D
WHERE GREASE LUBRICATION IS NECESSARY	Texaco Starfak Greases or Texaco Marfak No. 2 H.D.

HYDRAULIC SYSTEMS

HYDRAULIC SYSTEMS	
Normal service	Texaco Regal Oil A or B
Low temperature operation	Texaco Capella Oil A or B

NOTE:—A Texaco Lubrication Engineer is available for consultation in your territory and will be glad to make specific recommendations for your equipment.

Wherever a general machine lubricating oil is to be used as a cutting tool lubricant and coolant, it may be advisable to use a product of somewhat lower viscosity than any of the above. In such cases, a Texaco Lubrication Engineer also should be consulted.



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